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PCT/GB2005/002999

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Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

1. Your reference — Starch Activation 3

2. Patent application number *(The Patent Office will fill this part in)* — 0416914.0 — 29 JUL 2004

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

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   Patents ADP number *(if you know it)* — 8333072002

   If the applicant is a corporate body, give the country/state of its incorporation

4. Title of the invention — Starch Activation

5. Name of your agent *(if you have one)*

   "Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

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6. Priority: Complete this section if you are declaring priority from one or more earlier patent applications, filed in the last 12 months.

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*
UK	UK0410516.9	12/05/2004
UK	UK0413907.7	22/06/2004

7. Divisionals, etc: Complete this section only if this application is a divisional application or resulted from an entitlement dispute (see note f)

   Number of earlier UK application — Date of filing *(day / month / year)*

8. Is a Patents Form 7/77 (Statement of inventorship and of right to grant of a patent) required in support of this request? — Yes

   Answer YES if:
   a) any applicant named in part 3 is not an inventor, or
   b) there is an inventor who is not named as an applicant, or
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9. Accompanying documents: A patent application must include a description of the invention. Not counting duplicates, please enter the number of pages of each item accompanying this form:

Continuation sheets of this form	
Description	5
Claim(s)	
Abstract	
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10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent (Patents Form 7/77)	
Request for a preliminary examination and search (Patents Form 9/77)	
Request for a substantive examination (Patents Form 10/77)	
Any other documents (please specify)	

11. I/We request the grant of a patent on the basis of this application.

Signature(s) Date 28/7/04

12. Name, daytime telephone number and e-mail address, if any, of person to contact in the United Kingdom

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Starch Activation

This invention relates to a method of activating starch.

The present invention has reference to a method of activating or 'cooking out' starch in processing fluids at lower temperatures than would normally be possible, with application to, but not restricted to, the activation of modified starches in food processing at lower temperatures. In particular the present invention has reference to the activation of starches in fluids that are pumpable and include fluids such as liquid/solids suspensions, for example prepared foods such as sauces, or any flowable fluids or liquid/solids food mixtures over a range of viscosities.

It is well known in the art that modified starches, or carbohydrates, are used in food products for thickening, gelling, pasting. The final product properties, such as texture, sensory feel (mouth feel), aroma, and nutrition are directly influenced by the starch property. The modified starch used is dependent on the processing requirements, and its activation properties. Typically, starches are activated, which is sometimes referred to as 'cooked out' or 'gelatinised' by being heated, and each modified starch type is activated at a different temperature. It is also known that high shear on the product, for example from a paddle mixer, also influences the activation of the starch. However, once activated care must be taken to prevent damage to the starch through excessive heating or shearing, which results in a thinning of the product. This process is sometimes referred to as shear thinning.

In addition, the selection of the modified starch used in each process is also dependent on the requirements for pasteurisation. For example, a typical modified starch used in the manufacture of some types of sauces is activated at approximately 80°C-85°C. Care must be taken to prevent the temperature exceeding 85°C as heat damage to the activated starch begins and thinning of the product starts to occur. In this example, this type of starch is selected as it provides the desired processing properties and is activated at a temperature which is also convenient for pasteurisation. In this case, pasteurisation of the

sauce is achieved by holding the sauce mix in the temperature range of 80°C - 85°C for a set time.

For any given modified starch, which provides the properties required for a particular application, there is a significant advantage to be gained in activating the starch at as low a temperature as possible. Pasteurisation, if required, can still be achieved at lower temperatures by holding the product at the lower temperature for a slightly longer amount of time. However, many processes do not require pasteurisation, so activation of the starch at a low temperature is even more of an advantage. This provides production advantages of reduced energy requirements, reduces time to activate and reduced time and energy to later cool or chill the product prior to packaging.

Some of the more highly modified starches are more difficult to activate, often requiring higher temperatures and/or shearing. In many cases additional starch is added to the mix to compensate for starch which is not activated. Therefore, there are additional cost saving advantages in being able to activate these starches in a controllable and consistent manner.

An object of the present invention is to provide a method of activating starch in process fluids that are pumpable including fluids such as liquid/solids suspensions, for example prepared foods such as sauces, in a more effective manner and at a lower temperature than would normally be possible.

The method of the present invention is to pass the process fluid through a Fluid Mover of the kind described in our International Patent Application No PCT/GB2003/004400 in which the interaction of a process fluid or fluids and steam projected from a nozzle arrangement provides pumping, entrainment, mixing, heating, emulsification, homogenization etc of the process fluid or fluids. The fluid mover introduces an annular supersonic jet of transport fluid, typically steam, into a relatively large diameter straight through hollow passage. Through a combination of momentum transfer, high shear, and

the generation of a supersonic shockwave, the high velocity steam induces and acts upon the process fluid passing through the centre of the hollow body.

This fluid mover is particularly suitable for use in processing fluids such as liquid/solids suspensions often found in the food industry due to its ability to handle high fluid viscosities and large solid particle sizes. It is therefore almost impossible to block. In addition, due to its lack of moving parts, and subsequent lack of bearings, dynamic seals, and dynamic clearances, the fluid mover has particular relevance for use in the food industry due to its Clean in Place (CIP) properties.

The nature of the energy transfer between the steam and the process fluid affords significant advantages for use in starch activation. Due to the intimate mixing between the hot transport fluid (steam) and the process fluid, very high heat transfer rates between the fluids are achieved resulting in rapid heating of the process fluid. In addition, the high energy intensity within the unit, especially the high momentum transfer rates between the steam and process fluid result in high shear forces on the process fluid. It is therefore this combination of heat and shear that result in enhanced starch activation.

The fluid mover may be incorporated in either a batch or a single pass fluid processing configuration. One or more fluid movers may be used, possibly mounted in series in a single pipeline configuration. A single fluid mover may pump, heat, mix, and activate the starch, or a separate pump may be used to pass the process fluid through the fluid mover. Alternatively, two or more fluid movers may be used in series, each fluid mover may be configured and optimized to carry out different roles. For example, one fluid mover may be configured to pump and mix (and do some initial heating) and a second fluid mover mounted in series down stream of the first, optimized to heat.

The energy intensity within the fluid mover is controllable. By controlling the flow rates of the steam and/or the process fluid, the intensity can be reduced to allow slow heating of the process fluid, and provide a much lower shear intensity. This could be used, for

example, to provide gentle heating of the process fluid to maintain a batch of process fluid at a constant temperature without causing any shear thinning.

This method may also be employed for entraining, mixing in, dispersing and dissolving other hard-to-wet powders commonly employed in the food industry, such as pectins. Pectins are typically used to thicken foods or form gells, and are activated by heat. Some pectins form thermoreversible gels in the presence of calcium ions whereas others rapidly form thermally irreversible gels in the presence of sufficient sugars. The intense mixing, agitation, shear and heating afforded by the Fluid Mover enhances these gelling processes.

By way of example only, a fluid mover has been used to pump, mix, homogenise, heat (cook) and activate the starch in the manufacture of a 65kg batch of tomato based sauce. Conventional processing required the sauce to be heated to 85°C to activate the starch. It was found, using the fluid mover to mix, heat and process the sauce, that the starch was activated at the much lower batch temperature of 70°C. Combining this saving in heating requirement with the highly efficient mixing and heating afforded by the fluid mover, the overall process time was reduced by up to 95% over the conventional tank heating and stirring method.

It has also been found that the Fluid Mover activates a higher percentage of the starch present in the mix than conventional methods. It is not uncommon with food mixes containing highly modified starches for a large percentage (greater than 50%) of the starch to sometimes remain inactivated. Activating a higher percentage of the starch provides an obvious commercial advantage of reducing the amount of starch that has to be added to a mix to achieve a target viscosity. A similar effect has been observed with the (relatively) expensive pectin. Reducing the amount of pectin that has to be added to a mix provides a significant cost saving to the process.

This method may alternatively be employed in other processes which require rapid mixing, heating, hydration and starch activation. For example, this method may be

employed in the process of biofuel manufacture. One manufacturing method of biofuels such as ethanol, requires the ground base product such as grain to be mixed with water and cooked out. In some cases additional enzymes are added to the mix to convert the starch to sugar. Utilising the method described in this invention, the process of mixing, heating, hydrating and activating the starch can be achieved more rapidly and efficiently than conventional methods.

Similarly, this method may also be employed in the brewing industry. In a similar method to that used in the manufacture of biofuels, the brewing process requires the rapid mixing, heating and hydration of ground malt, known as grist, and activation of the starch. It has been found that this can be achieved using the method described in this invention, with the additional advantages of maintaining the integrity of both the enzymes and the husks of the grist. Maintaining integrity of the enzymes in the mix is important as they are required to convert the starch to sugar in a later process, and similarly, the husks are required to be of a particular size to form an effective filter cake in a later Lauter filtration process.